

## PATENT ABSTRACTS OF JAPAN

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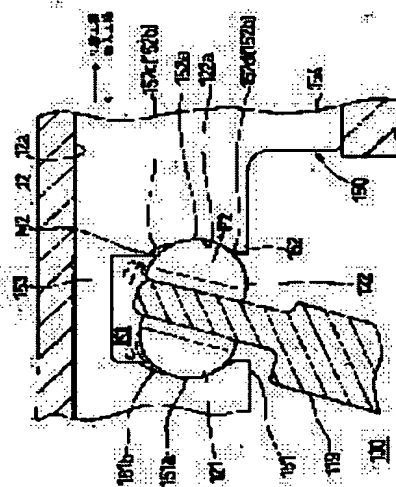
SAWA TOMOTAKA

## (54) PISTON FOR COMPRESSOR

## (57)Abstract:

PROBLEM TO BE SOLVED: To provide a piston for a compressor having a proper guide portion on a supporting seat for promoting guide and introduction of a lubricant between a recessed portion and a shoe without causing the enlargement of a supporting seat.

SOLUTION: The piston for the compressor comprises a head 154 reciprocally inserted in a cylinder for performing suction and compression of a working fluid in the cylinder and the supporting seat consisting of the semispherical recessed portion 152a arranged on the back side of the head for slide contacting the semispherical portion of the shoe and receiving thrust from the shoe and a lubricant guide portion 152b having an approximately annular slope chamfered along the peripheral edge of the recessed portion. The guide portion includes a narrower portion 152d of the slope and a wider portion 152c of the slope.



## LEGAL STATUS

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CLAIMS

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[Claim(s)]

[Claim 1] The head which is fitted in into a cylinder free [ reciprocation ] and performs inhalation and compression of a working fluid within this cylinder, The strike which consists of the interior of a proposal of the lubricating oil which consists of an abbreviation annular slant face beveled and formed along the periphery edge of an abbreviation semi-sphere-like crevice and this crevice which is arranged in the trailing side of this head and receives thrust from this shoe in slide contact with the semi-sphere section of a shoe, It is the piston for compressors characterized by said interior of a proposal having \*\*\*\*\* with the narrow width of face of said slant face, and the extension section with the wide width of face of this slant face in the piston for \*\*\*\*\* compressors.

[Claim 2] It is the piston for compressors according to claim 1 prepared in either of the periphery edges of the low press section where said extension section receives small thrust from said shoe among these crevices by preparing said \*\*\*\*\* in either of the periphery edges of the high press section which receives big thrust from said shoe among said crevices.

[Claim 3] It is the piston for compressors according to claim 2 prepared in the periphery edge of the low press section of this crevice in case said extension section has this head near a top dead center by preparing said \*\*\*\*\* in the periphery edge of the high press section of said crevice in case said head is near a top dead center.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the piston for compressors used for compressors, such as an air conditioning system (air conditioner).

[0002]

[Description of the Prior Art] Adjustment of the indoor temperature by the air conditioner (air-conditioner), humidity, an air current, and air purity is indispensable in order to offer comfortable space. The compressor (compressor) in a refrigerator (or heat pump) circulates a working fluid, and when the working fluid performs a refrigerating cycle (or heat pump cycle), it mainly succeeds in the temperature control by the air-conditioner etc. As such a compressor, there is a swash-plate-type compressor 400 as shown in drawing 6 (JP,6-249140,A). if a main shaft 416 rotates the swash-plate-type compressor 400 in response to power from a driving source -- a cam plate 419 -- rocking -- the piston 450 for compressors (a "piston" is called suitably hereafter) -- reciprocating -- a working fluid (refrigerant gas) -- inhalation and compression -- and the regurgitation is carried out. Here, the swash-plate-type compressor 400 made the semi-sphere-like shoes 421 and 422 intervene between a cam plate 419 and the strikes 451 and 452 of a piston 450, and has changed rocking rotation of a cam plate 419 into reciprocation of a piston 450. And the strikes 451 and 452 of a piston 450 have the crevice of the shape of an abbreviation semi-sphere which carries out inclusion of a part of semi-sphere section [ at least ] of shoes 421 and 422, and are arranged in the trailing side of heads 454 and 455.

[0003] By the way, in order to be carried out by stabilizing smooth sliding between each crevice of such strikes 451 and 452, and the semi-sphere section of shoes 421 and 422, a lubricating oil needs to be appropriately supplied among them. However, the swash-plate-type compressor 400 is not equipped with the supply means of a special lubricating oil by the request of the simplification of a device, lightweight miniaturization, etc. in many cases. For this reason, the swash-plate-type compressor 400 incorporates suitably the lubricating oil of the shape of Myst mixed with the blow-by gas of a working fluid (refrigerant gas) etc. to such a sliding part, and is performing the lubrication of such a part. And between crevices, the semi-sphere sections of a shoe, etc. with intense sliding is especially expected \*\*\*\*\* crack \*\*\*\*\* for installation of a lubricating oil. According to such a situation, the interior of a proposal (or chamfering-of-the-edge section) was conventionally established in the periphery edge of the crevice of a strike.

[0004] The strike 452 of the swash-plate-type compressor 400 which showed this situation to drawing 6 was taken for the example, and the enlarged drawing of that part was shown in drawing 5. In addition, drawing 5 (a) is the front view of a strike 452, and this drawing (b) is the sectional view. Interior of proposal 452b of a strike 452 carries out chamfering of the edge of the periphery edge of abbreviation semi-sphere crevice 452a almost equally, and is formed, and from the annular wedge-shaped clearance S made between interior of proposal 452b, and a shoe 422, a lubricating oil shows around between crevice 452a and semi-sphere section 422a of a shoe 422, and is introduced into it so that this drawing 5 may show.

[0005]

[Problem(s) to be Solved by the Invention] In order that an annular wedge-shaped clearance may expand such the interior of a proposal so that it is large, when promoting guidance of a lubricating oil, and installation, it is desirable. However, if the interior of a proposal is expanded, since the part by which chamfering of the edge is carried out will increase, the concave surface of the shape of a semi-sphere of a crevice decreases, the rise of the planar pressure between a crevice and a shoe is caused, and new problems, such as printing, may be generated. Moreover, it is also difficult to also ask a piston for lightweight miniaturization under the present condition that lightweight miniaturization of a compressor is called for, and for problems with other members, such as interference, to also aim at expansion inside a strike or a proposal for a certain reason.

[0006] On the other hand, the interior of a proposal does not necessarily need to be formed in

the periphery edge of a crevice at homogeneity for guidance of a lubricating oil, and installation. If the interior of a proposal expanded partially is rather established in a suitable part according to the gestalt of a compressor, a flow of the blow-by gas under the operation, etc., it will be thought that a lubricating oil can fully be guided and introduced to between a crevice and a shoe.

[0007] This invention is made in view of such a situation. That is, this invention aims at offering the piston for compressors which equipped the strike with the interior of a proposal where the degree of freedom which can promote guidance of the lubricating oil of a between [ a crevice and shoes ] and installation under suitable conditions is big.

[0008]

[Means for Solving the Problem] Then, as a result of inquiring wholeheartedly that this technical problem should be solved and repeating trial-and-error, this invention person thinks of forming the extension section and \*\*\*\*\* in the interior of the proposal of the strike of the piston for compressors, and used to come to develop the processing approach of the strike of the piston for compressors of this invention.

[0009] Namely, the piston for compressors of this invention The head which is fitted in into a cylinder free [ reciprocation ] and performs inhalation and compression of a working fluid within this cylinder, The strike which consists of the interior of a proposal of the lubricating oil which consists of an abbreviation annular slant face beveled and formed along the periphery edge of an abbreviation semi-sphere-like crevice and this crevice which is arranged in the trailing side of this head and receives thrust from this shoe in slide contact with the semi-sphere section of a shoe, In the piston for \*\*\*\*\* compressors, said interior of a proposal is characterized by having \*\*\*\*\* with the narrow width of face of said slant face, and the extension section with the wide width of face of this slant face.

[0010] Since the piston for compressors concerning this invention equips the interior of the proposal of a strike with the extension section, it can promote guidance of the lubricating oil from the part to a crevice and the sliding section of a shoe, and installation, and may stabilize the sliding nature between them more. On the other hand, since it also has \*\*\*\*\*, reduction of the sliding area of the shape of an abbreviation semi-sphere of a crevice is hardly caused, but the rise of the planar pressure between a crevice and a shoe is controlled, and wear between them etc. can be controlled. In addition, a flat surface or curved surfaces, such as the spherical surface, are sufficient as the "slant face" inside a proposal, and zero are [ "\*\*\*\*\*" may not have substantial width of face, or / that is, ] substantially sufficient as it. If such the extension section is prepared in the location which is easy to incorporate a lubricating oil according to a flow of the blow-by gas in the compressor containing a lubricating oil etc., it is suitable. On the contrary, \*\*\*\*\* is good for the incorporation of a lubricating oil to prepare in a part expectable [ seldom ], and to receive the thrust from a shoe in the crevice near [ the ] \*\*\*\*\*.

[0011] Moreover, the extension section and \*\*\*\*\* may be arranged as follows. That is, said \*\*\*\*\* is prepared in either of the periphery edges of the high press section which receives big thrust from said shoe among said crevices, and if said extension section is prepared in either of the periphery edges of the low press section which receives small thrust from said shoe among these crevices, it is suitable. Since \*\*\*\*\* inside a proposal is located in the periphery edge of the crevice used as the high press section, it is the part, and the sliding (slide contact) area of a shoe and a crevice increases, can control and reduce the planar pressure between them, and is effective in prevention of wear etc. On the other hand, in the low press section, even if the sliding (slide contact) area of a crevice and a shoe decreases by formation of the extension section, the rises of the planar pressure between them are few, and a problem does not become. And the efficient incorporation of a lubricating oil is expectable from near [ the ] the extension section.

[0012] In addition, the momentary location of the high press section and the low press section changes with migration of a piston, and the location changes with a compression stroke or charging strokes. However, a crevice can be divided into the part which receives comparatively big thrust, and the part which seldom receives thrust if it sees in 1 cycle (or half cycle) of a piston. For example, when the piston of a swash-plate-type compressor is in a compression stroke, the crevice of one strike receives big thrust in the part of abbreviation one half, and seldom receives thrust in the opposite side.

[0013] Moreover, said \*\*\*\*\* is prepared in the periphery edge of the high press section of said crevice in case said head is near a top dead center, and if said extension section is prepared in the periphery edge of the low press section of this crevice in case this head is near a top dead center, it is suitable. For example, when a piston is in a compression stroke and a head is near a top dead center, since a working fluid is high pressure, a crevice receives quite big thrust. If \*\*\*\*\* is prepared in the periphery edge of the high press section at this time, since the area in which it \*\*\*\*\* between a crevice and a shoe will increase, it is desirable when aiming at

control of the planar pressure between them, and reduction. On the contrary, if the extension section is prepared in the periphery edge of the small low press section of thrust, guidance of a lubricating oil and promotion of installation can be aimed at controlling the rise of planar pressure, and it is convenient. These are also the same as when a piston is in a charging stroke. When a head is near the top dead center of a charging stroke, it is because the inside of a cylinder serves as negative pressure and a crevice receives big thrust.

[0014] In addition, the piston for compressors of this invention is not restricted to the piston of a swash-plate-type compressor or a WABBURU type compressor, but can be widely applied to a piston for compressors which was mentioned above. Moreover, in the case of the piston for swash-plate-type compressors, the strike which faced in opposite directions to the head of the piston which mainly receives thrust at the time of a compression stroke directly is sufficient, and a strike is [ a strike may be countered and prepared in the strike which mainly receives thrust at the time of a charging stroke, and ] sufficient as it. Moreover, a variable-capacity mold or a fixed capacity mold is sufficient as the compressor which a piece head form piston or both the head form piston is sufficient as a piston, and uses the piston, and the compressor which may perform not only a refrigerating cycle but a heat pump cycle, and is used not only as the object for cars but as still more nearly general-purpose is sufficient as it.

[0015]

[Embodiment of the Invention] (The 1st operation gestalt) The piston 150 for compressors which is the 1st operation gestalt of this invention is explained using drawing 1 and drawing 2. This piston 150 ("a piston 150" is only called hereafter.) for compressors is this configuration as fundamentally as the piston 450 for both head swash-plate-type compressors shown in drawing 6, and presupposes that it is included in the swash-plate-type compressor 100 for convenience as shown in drawing 1. Moreover, a piston 150 is both the head type, and since the situation is the same at an each side, it mainly explains only one side.

[0016] As shown in drawing 1, a piston 150 consists of the cylinder-like head 154, the strike 152 formed in this head 154 by facing in opposite directions, the neck 153 prolonged ahead (left of drawing 1) from the periphery side (upper part of drawing 1) of a head 154, a strike 151 which counters a strike 152 and extends in an inner circumference side (lower part of drawing 1) from the front end side of a neck 153, and a head 155 (illustration abbreviation) which faces in opposite directions to that strike 151 further. And the abbreviation K0 character-like space K1 is formed of a strike 151, a neck 153, and a strike 152, and the periphery part of a cam plate 119 can carry out rocking rotation in this space K1. And when the shoes 121 and 122 of the shape of an abbreviation semi-sphere which can be freely rocked between strikes 151 and 152 and a cam plate 119 intervene, a piston 150 reciprocates within cylinder 12a in a cylinder block 12 with rocking rotation of a cam plate 119.

[0017] Next, the strike 151 and strike 152 concerning this invention are described in detail using drawing 1 and drawing 2. Drawing 2 is what expanded and expressed the configuration of crevice 152a of a strike 152, and interior of proposal 152b, this drawing (a) is a front view of a strike 152, and this drawing (b) is an A-A sectional view of this drawing (a). First, a strike 152 is equipped with interior of proposal 152b which abbreviation semi-sphere-like crevice 152a and a periphery edge become from the abbreviation annular slant face which chamfering of the edge was carried out and was formed in the shape of the spherical surface. Although mentioned later, with this operation gestalt, crevice 152a and interior of proposal 152b are considered as the shape of the spherical surface with the same radius of curvature in order to aim at improvement in processing effectiveness. Of course, even if those radius of curvatures differ, it may be satisfactory in any way, and a superficial slant face is sufficient as the interior of a proposal. And annular interior of proposal 152b has large extension section 152c of slant-face width of face in the periphery side (upper part side of drawing 1 and drawing 2) of the swash-plate-type compressor 100, and has 152d of \*\*\*\*\* with narrow slant-face width of face in the inner circumference side (the drawing 1 side, lower part side of drawing 2). And slant-face width of face is changing from extension section 152c to 152d of \*\*\*\*\* smoothly. In this way, annular interior of proposal 152b is formed.

[0018] By the way, when the head 154 of a piston 150 is in a compression stroke and it is as are especially shown in drawing 1 and a head 154 reaches a top dead center, a shoe 122 and a strike 152 receive big thrust in the direction of F2 from a cam plate 119. That is, a shoe 122 tends to slide to the cam plate which receives compression reaction force in response to the component of a force to a lower part (the drawing 1 side, lower part side of drawing 2). Therefore, as shown in drawing 2 (a), crevice 152a receives big thrust in the high press section PL 1 (range enclosed with a two-dot chain line) by the side of the inner circumference (lower part side of drawing 2). On the other hand, only small thrust is received in the low press section PS 1 (range enclosed with a two-dot chain line) by the side of the periphery of crevice 152a (upper part side of drawing 2). And since 152d of \*\*\*\*\* of interior of proposal 152b is located in the periphery edge of the high press section PL 1, it means that the slide contact area of a required part was

expanded substantially, without being accompanied by expansion of a strike 152. Therefore, it is effective, when the planar pressure which acts there is controlled, falls and aims at control of wear of semi-sphere section 122a of the semi-sphere concave surface of crevice 152a, or a shoe 122, reduction, etc.

[0019] On the contrary, since extension section 152c of interior of proposal 152b is located in the periphery edge of the low press section PS 1, the expanded wedge-shaped space M2 is formed, and guidance of the lubricating oil to the sliding section of crevice 152a and a shoe 122 and installation are promoted. Therefore, the sliding nature between them is held stably and is desirable. And it is convenient in order to cause neither expansion of a strike 152, nor reduction of the area of crevice 152a. Although explained focusing on the strike 152 in case the head 154 of a piston 150 is in a compression stroke, the same thing can be said also when the head 155 of a piston 150 is in a compression stroke. In addition, it refuses that it is the strike which not only the strike 152 but the strike 151 has in a trailing side seen from a head 154 or a head 155.

[0020] (The 2nd operation gestalt) Next, the 2nd operation gestalt of the piston for compressors of this invention is explained using drawing 3. The piston 250 ("a piston 250" is only called hereafter.) for compressors shown here is a piston for \*\*\*\* swash-plate-type compressors, and the configuration the crevice of a strike and inside a proposal also differs from the thing of a piston 150. Here, although the strike 252 which receives big thrust is taken up and explained to a compression stroke, a strike 251 can be considered the same way, if arrangement with \*\*\*\*\* and the extension section is made reverse.

[0021] As shown in the front view of a strike 252 shown in drawing 3 (a), 252d of \*\*\*\*\* of interior of proposal 252b of this strike 252 is displaced in the direction of inner circumference side slant (the direction of the drawing 3 lower right) for a while, they are formed in it, and extension section 252c is displaced in that opposite direction of periphery side slant (the direction of the drawing 3 upper left) for a while, and is formed in it. This reason is explained below. Drawing 3 (b) shows the top view which saw the piston 250 from the periphery side (upper part side of drawing 3 (a)). When it is as shown in this drawing, and a piston 250 reaches a top dead center in a compression stroke, according to the include angle alpha of a cam plate 219, the direction of the thrust which crevice 252a of a shoe 222 and a strike 252 receives changes. For example, although thrust acts in the direction of F3 in the condition of (I) that the cam plate 219 has accomplished the include angle alpha as shown in drawing 3 (b), in the time of the condition of (II) near a top dead center, thrust acts in the direction of F4. However, the direction of thrust is a three-dimension target which also includes an inside-and-outside hoop direction that it is not two-dimensional and actually as shows drawing 3 (b).

[0022] With this operation gestalt, based on such a thing, not only near a top dead center but the thrust in the middle of resulting there is taken into consideration, the high press section PL 2 is considered, 252d of \*\*\*\*\* is prepared in the periphery edge of that crevice 252a, and extension section 252c is prepared in the periphery edge of crevice 252a according to the low press section PS 2 made in that opposite side.

[0023] (Processing of a piston) Next, a piston 150 is taken for an example and an example of the processing approach the crevices 151a and 152a of strikes 151 and 152 and inside [ 151b and 152b ] a proposal is shown. On the occasion of this processing, strike processing equipment 10 as shown in drawing 4 was used. Strike processing equipment 10 is equipped with the cutting-edge implement 171 and the cutting-edge implement 172 which inclined at an angle of [ theta ] predetermined. These cutting-edge implements 171 and 172 are attached in arms 161 and 162, respectively, and they can move [ arms / 161 and 162 ] the core C of a cutting part annularly in accordance with Centroid T while they may rotate the cutting-edge implements 171 and 172 to the circumference of a shaft. In addition, this annular movement can perform not only the circular motion but ellipse movement etc. by numerical control.

[0024] Moreover, arms 161 and 162 are attached in a head 160, and can move a head 160 to a perpendicular direction V and a horizontal direction H free. Moreover, the piston 50 which is a work piece is being fixed by the fasteners 181 and 182 on a table 180. Moreover, the cutting-edge implement 172 (the same is said of cutting-edge implement 171) consists of chip 172c of the shape of semidisc attached at the tip of major-diameter shank 172a, minor diameter shank 172b prolonged at a tip from there, and minor diameter shank 172b.

[0025] Next, the procedure of processing is shown. This strike processing equipment 10 moves a head 160 to a horizontal direction H and a perpendicular direction V suitably, and it inserts chip 172c of the cutting-edge implement 172, and minor diameter shank 172b in the abbreviation K0 character-like space K1, maintaining the cutting-edge implement 172 at the tilt angle theta to a table 180. And an arm 162 carries out annular movement (contouring) of the core C in accordance with the predetermined centroid T by the program beforehand set as the control section (not shown), holding the tilt angle theta for the cutting-edge implement 172 (interior formation process of a proposal). Thereby, interior of proposal 152b which consists of an annular

spherical-surface-like slant face is formed first. And if it re-sets to the location which was able to shift the core C of the cutting-edge implement 172 in the direction of inner circumference (upper part of drawing 4 ) slightly from the core of the above-mentioned centroid T and only the specified quantity drives the core C of the cutting-edge implement 172 into the shaft orientations (method of the right of drawing 4 ) of a piston 150, crevice 152a will be formed (crevice formation process).

[0026] In this way, if the cutting-edge implement 172 is made to shunt and a strike 151 is similarly processed using the cutting-edge implement 171 after processing of a strike 152 is completed, processing of the strikes 151 and 152 of a piston 150 will be completed. Although mentioned above, the interior formation process of a proposal and a crevice formation process do not necessarily need to use the cutting-edge implement of the diameter of said, and may process it separately with a different cutting-edge implement. Moreover, the interior formation process of a proposal may form the slant face on a flat surface.

[0027] (in addition to this) Ellipse annular besides the shape of a circular ring etc. is sufficient as the interior of a proposal. Moreover, even if it is not annular [ perfect ], you may break off in part by \*\*\*\*\*. In the case of the piston for swash-plate-type compressors, at least one side of a strike does not need to be both that what is necessary is just a strike like this invention. Moreover, when the piston for swash-plate-type compressors is a cast and the inside (near the root of a neck) of a strike is thick by the draft etc., it is good also as the extension section inside a proposal using this.

[0028]

[Effect of the Invention] While preventing the planar pressure rise between a shoe and the crevice which receives it according to the piston for compressors of this invention, without causing expansion of a strike etc., the suitable interior of a proposal which can promote guidance of the lubricating oil of a between [ a crevice and shoes ] and installation can be formed in a strike.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the condition of having included the piston concerning the 1st operation gestalt of this invention in the swash-plate-type compressor.

[Drawing 2] It is the partial enlarged drawing showing the strike of the piston concerning the 1st operation gestalt of this invention, and this drawing (a) is a front view of the strike, and this drawing (b) is an A-A sectional view of this drawing (a).

[Drawing 3] It is drawing showing the piston concerning the 2nd operation gestalt of this invention, and this drawing (a) is a front view of the strike, and this drawing (b) is a top view of the piston.

[Drawing 4] It is the conceptual diagram showing the processing equipment and the processing approach of a strike of a piston concerning this invention.

[Drawing 5] It is drawing showing the strike of the conventional piston for compressors, and this drawing (a) is a front view of the strike, and this drawing (b) is a B-B sectional view of this drawing (a).

[Drawing 6] It is drawing showing the conventional swash-plate-type compressor.

[Description of Notations]

150 Piston for Compressors

152 Strike

152a Crevice

152b The interior of a proposal

152c Extension section

152d \*\*\*\*\*

154 Head

122 Shoe

12a Cylinder

PL1 Quantity press section

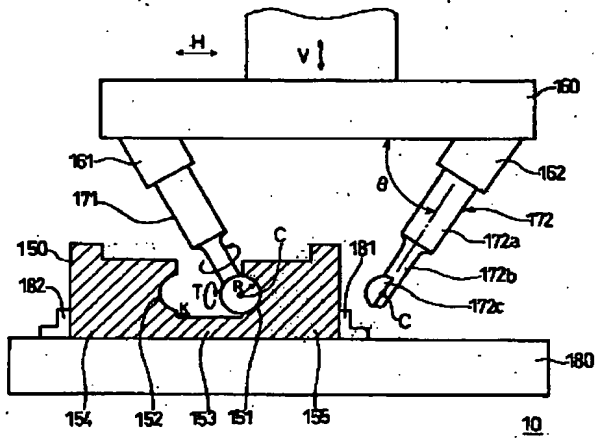
PS1 Low press section

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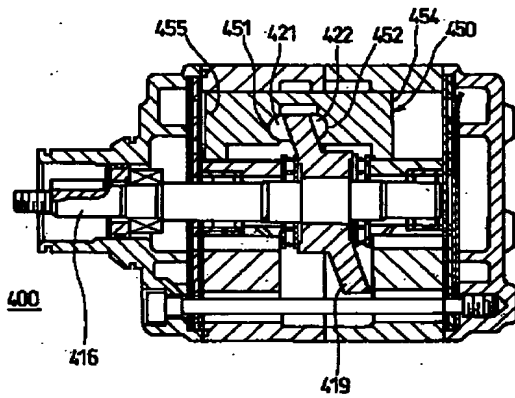
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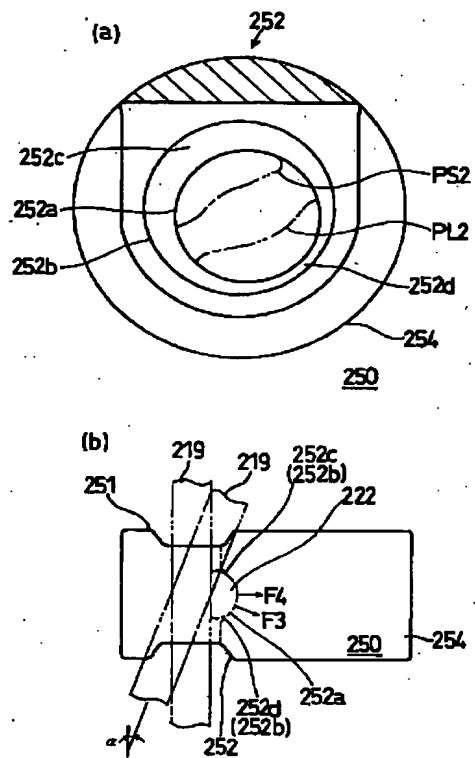




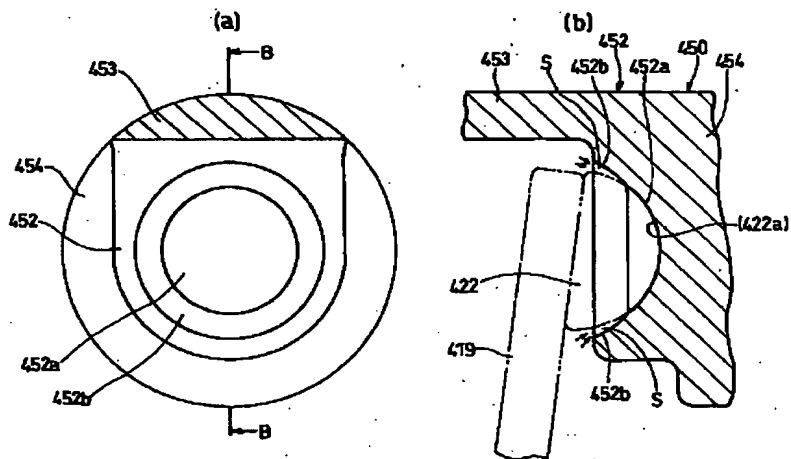
[Drawing 6]



[Drawing 3]



[Drawing 5]



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